

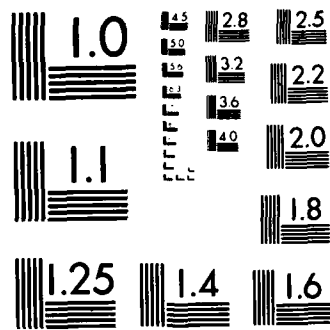
AD-A131 873 PROBABILITY FORECAST VERIFICATION AIDS(U) WEATHER WING 1//1
(2ND) APO NEW YORK 09012 R G BACHMAN 01 APR 79
2WMTTN-79-007 BB--AD-E850 387

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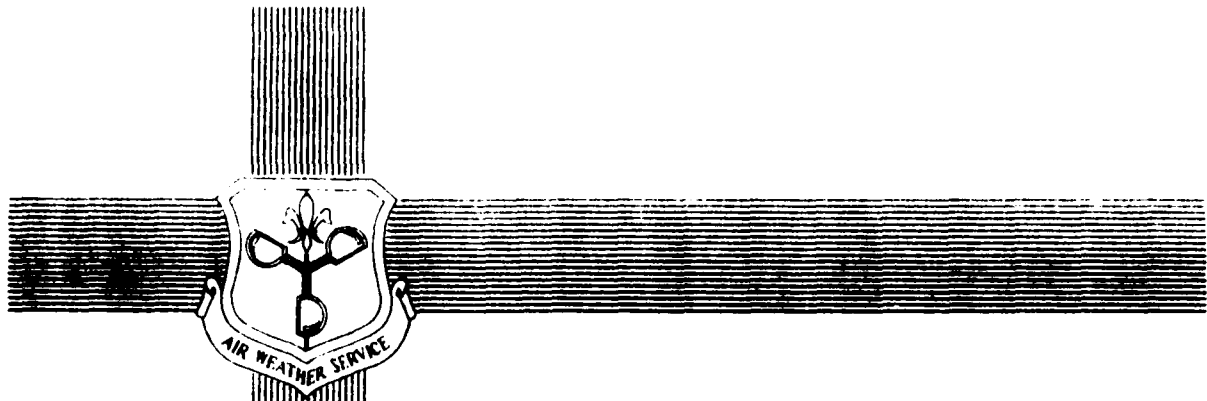




MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

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PROBABILITY FORECAST VERIFICATION AIDS

By

CAPT ROBERT G. BACHMAN



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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) The purpose and use of two worksheets designed for collection and analysis of probability forecast data is explained. Instructions for use of HP-97 computer software for computing Brier Score and related statistics are also provided.		

PROBABILITY FORECAST VERIFICATION AIDS

1. Introduction. 2WW/DNS has developed worksheets and HP-97 programmable calculator software to facilitate probability forecasting data gathering and analysis, and to assist 2WW field units in probability forecasting tasks. Instructions follow for completion of the worksheets and for use of the HP-97 software. Further background on this subject is contained in AWSP 105-51 and 2WW TN 79-1. (2WW TNs 78-1, 78-4, 78-6 and 79-6 also provide background on probability forecasting). Both the Form 26 and 28 are intended primarily as individual forecaster worksheets. The intent is for forecasters to maintain data on their own forecasts and to analyze the reliability and sharpness on a periodic basis (normally, but not necessarily, monthly). This procedure provides forecaster feedback which is the primary purpose for this type of forecast verification. The computation of the Brier Score and associated statistics as a general rule should only be accomplished for overall unit data. It can be done for individuals, but this is not recommended. As a general rule the tracking of skill scores from month to month is to be minimized in favor of time spent on analysis and correction of the bias in unit and individual reliability and sharpness data.

2. Use of 2WW Form 26 and 2WW Form 28.

a. Form 26. Figure 1 is an example of a completed Form 26. This example is from a series (20) of 4 category forecasts. The form can be used for 2 through 5 categories. There are two distinct sections on the form. The first twenty lines are used for recording forecasts (circled letters) and observations (check marks). The last eight lines are used for summarizing the data.

(1) In the example on the first line a ceiling forecast of 0181 is recorded. This forecast is recorded then by circling the Cat A forecast under Pf = 0%, the Cat B and D under Pf = 10%, and the Cat C under Pf = 80%. The observation is recorded by entering a check mark in the block where the appropriate category has been circled. In the example the 12 Feb 24 hour forecast is noted that both Category C and D were forecast at 40%. In such cases the category which was observed must be annotated along with the check mark.

(2) The summary section on the example has circled numbers in the left and right margins which are used here for reference. Data is recorded based on what hours are to be verified (3 to 24 in the example), however, the summary is accomplished for all hours combined. The purpose for collecting multiple hour verification is to build a more reliable and representative data base.

Row ①. In each block along this row the sum of Cat A observations (check marks) is tabulated. Zeros are not indicated. In the example there were no Cat A observations.

Row ② ③ ④ ⑤. These rows are the summations (as was row ①) of the number of observations for the indicated categories. The purpose of rows ① through ⑤ is to facilitate calculation of the category frequencies. This is done by dividing each of the sums on the right (next to rows ② through ⑤) by the total number of observations. On the example 4 categories are used; consequently, row 5 is lined out.

Row ⑥. The sum of the observations (checks) in each column.

Row ⑦. The sum of the total number of circles (forecasts per Pf in each column).

Row ⑧. The quotient of O/Tf or row ⑥ divided by row ⑦.

Row ⑨ and ⑩. A double check to insure no errors have been made in the tabulation. A horizontal sum across row ⑥ will always total 20 if the sheet is full. The sum of row ⑦ indicated in ⑩ will equal the product of the value in ⑨ times the number of categories in use. If these two summations do not check out a tabulation error has been made.

As a general rule 20 forecasts are not a large enough sample to gain benefit from the analysis, consequently, two or three forms should be completed before the data is tabulated.

b. Form 28. The primary purpose for this form is to provide space for graphing and analysis of reliability and sharpness data. Data can be transferred directly from the Form 26 to the Form 28 to facilitate this task. Space is provided for two sets of forecast data. See Figure 2 for example.

(1) To plot reliability the Pf value is plotted on the vertical axis and the ratio (observed frequency) O/Tf is plotted on the horizontal axis. Refer to AWSP 105-51 for background and instructions on the interpretation of reliability data.

(2) Sharpness is a plot of Pf (vertical axis) against Tf, the number of forecasts for each Pf value. Again refer to AWSP 105-51 for interpretation.

Form 28 can be forwarded to 2WW/DN for computation of the Brier Score and associated statistics and analysis of reliability and sharpness. This data can also be called in by phone if only computations are needed. The data should be read in the sequence indicated on Figure 3. The data can be punched into the computer and the statistics read back in a matter of minutes. The computer software and its use is described in Section 4. Both the form 26 and 28 are still test forms and are subject to minor modification, however, this will not change the way the forms are used.

3. To use the HP-97 software for computing the Brier Score, the Brier Score Standard, improvement over standard (IOS) and percent of possible improvement over standard (PPIOS) the following instructions must be followed. The input data is all on 2WW Form 28. The sequential numbers in bold handwriting on Figure 3 are to be punched in the order indicated. In each case below "enter" means punch the number into the X register. Figure 4 is a copy of the program

Step 1. Load the program

Step 2. Enter N, (1) then punch STO E

Step 3. Enter (2) then punch B followed by R/S.

Step 4. Enter (3) through (20) punching R/S after each number entered.

Note that the X'd out blocks under Pf = .0 and .5 are not entered into the calculator.

Step 5. Enter (21). The calculator will automatically begin to compute and will print the Brier Score. It takes approximately 10 seconds for the program to run.

Step 6. Enter (22) through (26) the calculator will print the standard, the IOS and the PPIOS - in that order. If less than five categories are used zero must be entered for each Cat frequency not represented; e.g. (24), (25) and (26) would all be zero in a two category situations.

Accession #		<input checked="" type="checkbox"/>
MIS		
DTIS		
Unannounced		
Justification		
By		
Distribution/		
Availability Codes		
Dist	Avail and/or Special	
A		

FORM A - PROBABILITY FORECAST DATA LOG

FCSTR

BS

UNIT

2WW

MENT FORECAST

CIG

CATEGORY LIMITS

 $\begin{matrix} < 200 & 3 & 200 & 1 & > 200 & 2 & 3 & 200 & 3 \\ A & 1/2 & B & 100 & 2 & C & 300 & 3 & D & 300 & 3 \\ & & & & & & & & & & E & - \end{matrix}$

ISSUE DTG	VALID DTG	Pf	0	10	20	30	40	50	60	70	80	90	100	
2 FEB	3	0	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	0181
	24	0	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	0163
5 FEB	3	0	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	0721
	24	0	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	0136
6 FEB	3	00	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	0037
	24	00	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	0037
12 FEB	3	0	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	0352
	24	0	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	0244
13 FEB	3	00	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	0037
	24	0	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	0145
15 FEB	3	0	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	0631
	24	0	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	0127
20 FEB	3	0	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	0226
	24	0	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	0631
22 FEB	3	00	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	0019
	24	00	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	0037
23 FEB	3	0	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	0343
	24	0	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	0127
2 FEB	3	000	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	0009
	24	000	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	0009
CAT A	0													0
CAT B	0	1							1	1				3
CAT C	0			1	2	2					1			6
CAT D	0		1	1	1	1			1	3		1	2	11
CAT E	0													
ALL CAT	0	1	1	2	3	3	0	2	4	1	1	2	20	20
ALL CAT T _f	24	11	7	11	4	2	5	6	2	1	2	2	80	80
ALL CAT O/T _f	0.3	0.9	0.29	0.27	0.75	0.00	0.40	0.67	0.50	1.0	1.0			

DEFINITIONS:

= The sum of the occurrence in a given category for each Pf.

T_f = The sum of the circled forecast in a given category for each Pf.O/T_f = The quotient of the summed Os and T_f. i.e. (C₁+O₂)/(T_{f1}=T_{f2})

Brier Score

Standard

IOS

PPIOS

FORM
2WW OCT 78 26 TEST

PREVIOUS EDITION IS OBSOLETE

FORM 9

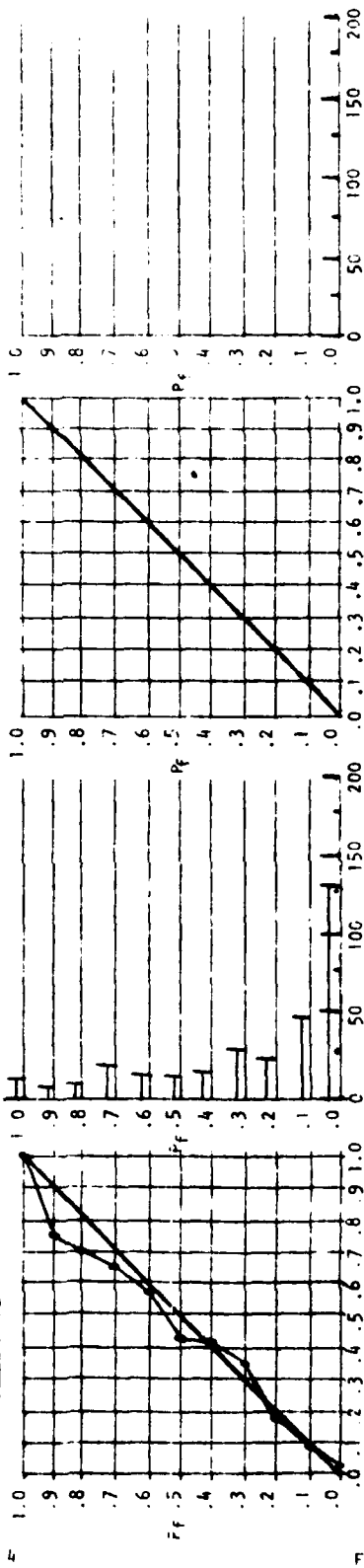
BRIER SCORE TABULATION SHEET

PERIOD

UNIT OR FCST 88 CAT CEILING FORECASTS 4 CAT 3424 TOTAL # FORECASTS (N) 80 CAT FREQ 1002093344585

P _i	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9	1.0	FORECAST CHARACTERISTIC
0	2	4	4	9	7	6	8	15	7	6	12	BRIER SCORE .4303 STANDARD .5394
T _f	131	46	32	26	17	14	14	20	10	8	12	5-16-1 OVERCONFIDENCE INDICATED BY OVERUSE OF .7, .8 & .9
O	.02	.04	.18	.135	.41	.43	.57	.75	.70	.75	1.0	IPPOS 22.2
T _f												BRIER SCORE STANDARD IPPOS

RELIABILITY 3424 HR ALLCAT SHARPNESS 3424 HR ALLCAT



DEFINITIONS: O = Occurrences (hits) per P_f
T_f = # Forecasts issued per P_f
O/T_f = # Occurrences per P_f

NOTE: THE DATA ON THIS FORM DOES NOT MATCH THAT ON A7CH1

FORM 28 TEST 2M1 OCT 78

PREVIOUS EDITION IS OBSOLETE

FORM 5

BRIER SCORE TABULATION SHEET

PERIOD

(22) (23) (24) (25) (26)

UNIT OR FCSTR

HOUR (S)

TOTAL # FORECASTS (N) (1)

CAT FREQ

Pf	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9	1.0	FORECAST CHARACTERISTICS
0	(2)	(3)	(5)	(7)	(9)	(12)	(14)	(16)	(18)	(20)		BRIER SCORE STANDARD
Tf	(4)	(6)	(8)	(10)	(11)	(13)	(15)	(17)	(19)	(21)		LOS
O/Tf												PPLOS
0												BRIER SCORE STANDARD
Tf												LOS
O/Tf												PPLOS

RELIABILITY

SHARPNESS

RELIABILITY

SHARPNESS

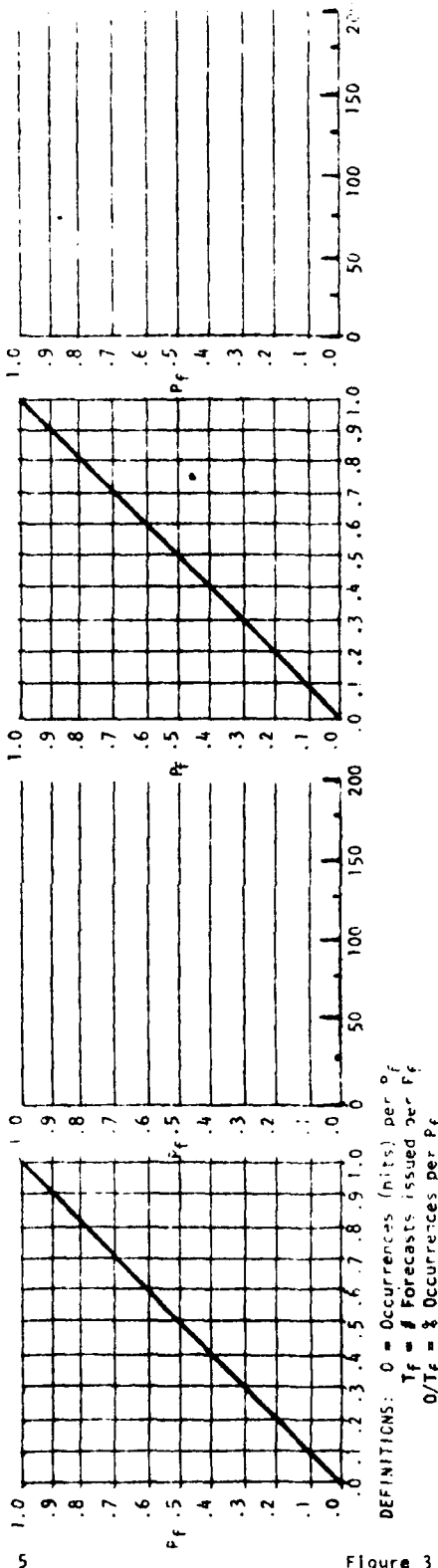


Figure 3

FORM 28 TEST
 2ND OCT 78

PREVIOUS EDITION IS OBSOLETE

HP-97 PROGRAM

```

001 LBLB 21 12
002 R/S 51
003 STO0 35 00
004 R/S 51
005 STO1 35 01
006 R/S 51
007 STO2 35 02
008 R/S 51
009 STO3 35 03
010 R/S 51
011 STO4 35 04
012 R/S 51
013 STO5 35 05
014 R/S 51
015 STO6 35 06
016 R/S 51
017 STO7 35 07
018 R/S 51
019 STO8 35 08
020 R/S 51
021 STO9 35 09
022 P/S 16-51
023 R/S 51
024 STO0 35 00
025 R/S 51
026 STO1 35 01
027 R/S 51
028 STO2 35 02
029 R/S 51
030 STO3 35 03
031 R/S 51
032 STO4 35 04
033 R/S 51
034 STO5 35 05
035 R/S 51
036 STO6 35 06
037 R/S 51
038 STO7 35 07
039 R/S 51
040 STO8 35 08
041 R/S 51
042 STO9 35 09
043 P/S 16-51
044 LBLA 21 11
045 RCL0 36 00
046 ENT  -21
047 RCL1 36 01
048 ENT  -21
049  -62
050 8 08
051 X -35
052 + -55
053 RCL2 36 02
054 ENT  -62
055  -62
056 0 00
057 1 01
058 X -35
059 + -55
060 RCL3 36 03
061 ENT  -21
062  -62
063 6 06
064 X -35
065 + -55

```

```

066 RCL4 36 04
067 ENT  -21
068  -62
069 0 00
070 4 04
071 X -35
072 + -55
073 RCL5 36 05
074 ENT  -21
075  -62
076 4 04
077 X -35
078 + -55
079 RCL6 36 06
080 ENT  -21
081  -62
082 0 00
083 9 09
084 X -35
085 + -55
086 RCL7 36 07
087 ENT  -21
088  -62
089 2 02
090 X -35
091 + -55
092 RCL8 36 08
093 ENT  -21
094  -62
095 1 01
096 6 06
097 X -35
098 + -55
099 RCL9 36 09
100 ENT  -21
101  -62
102 2 02
103 5 05
104 X -35
105 + -55
106 P/S 16-51
107 RCL0 36 00
108 ENT  -21
109  -62
110 2 02
111 X -35
112  -45
113 RCL1 36 01
114 ENT  -21
115  -62
116 3 03
117 6 06
118 X -35
119 + -55
120 RCL2 36 02
121 ENT  -21
122  -62
123 4 04
124 X -35
125  -45
126 RCL3 36 03
127 ENT  -21
128  -62
129 4 04
130 9 03

```

```

131 X -35
132 + -55
133 RCL4 36 04
134 ENT  -21
135  -62
136 6 06
137 X -35
138  -45
139 RCL5 36 05
140 ENT  -21
141  -62
142 6 06
143 4 04
144 X -35
145 + -55
146 RCL6 36 06
147 ENT  -21
148  -62
149 8 08
150 X -35
151  -45
152 RCL7 36 07
153 ENT  -21
154  -62
155 8 08
156 1 01
157 X -35
158 + -55
159 RCL8 36 08
160  -45
161 RCL9 36 09
162 + -55
163 RCL0 36 15
164 ÷ -24
165 PRTX -14
166 ENT  -21
167 R/S 51
168 X2 53
169 R/S 51
170 X2 53
171 + -55
172 R/S 51
173 X2 53
174 + -55
175 R/S 51
176 X2 53
177 + -55
178 R/S 51
179 X2 53
180 + -55
181 1 01
182 X↔Y -41
183  -45
184 RPTX -14
185 STOC 35 13
186 X↔Y -41
187  -45
188 PRTX -14
189 RCL0 36 13
190 ÷ -24
191 PRTX -14
192 RTN 24
193 R/S 51

```

Note: The three columns shown here are a direct reproduction of the computer listing from the HP-97. Only the middle line of data in each column are keystrokes. The left line of data are program sequence numbers. The right line of data are keystroke code figures.

END

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